Facet Into Multiple Views

Idiom: Small multiples
- encoding: same
- data: none shared
- navigation: shared
- different attributes for node colors
- (same network layout)

Idiom: Overview-detail navigation
- encoding: same
- data: subset shared
- navigation: shared
- bidirectional linking
- unidirectional linking

Why not animation?
- disparate frames and regions comparison difficult
  - vs contiguous frames
  - vs small region
  - vs coherent motion of group
- safe special case
  - estimated transitions

Eyes beat memory
- principle: external cognition vs. internal memory
  - easier to compare by moving eyes between side-by-side views
  - harder to compare visible item to memory of what you saw
- implications for animation
  - great for choreographed storytelling
  - great for transitions between two states
  - poor for many states with changes everywhere
  - consider small multiples instead

Change blindness
- if attention is directed elsewhere, even drastic changes not noticeable
- --door experiment
- --change blindness demos
- --mask in between images

System: EDV
- linked highlighting
- why juxtapose views?
  - benefits: eyes vs memory
    - lower cognitive load to move eyes between 2 views than remembering previous state with angle changing view
  - costs: display area, 2 views side by side each have only half the area of one view

Linked views
- unidirectional vs bidirectional linking

System: Improvise
- partition into views
- investigation power of multiple views
  - pushing limits on view capture
  - interaction complexity
  - how many is ok?
  - open research question
  - reordering lists
  - easy lookup
  - useful when linked to other encodings

System: Google Maps
- overview-detail views
- encoding: same
- data: subset shared
- navigation: shared
- differences
  - isocontours
  - isochromes
- special case: birds-eye map

System: Cerebral
- partition into views
- how to divide data between views
  - split into regions by attributes
  - encodes association between views
  - object with internal structure that arises from multiple marks

System: Baskets
- partition into view side by side views
- various big data
  - contiguous region in which visually encoded data is shown on the display
- phah: small views
  - object with internal structure that arise from multiple marks

System: Improvise
- how to divide data between views
  - splits into regions by attributes
  - encodes association between views using spatial proximity
  - order of splits has major implications for what patterns are visible
- no strict dividing line
- --meta big data
  - contiguous region in which visually encoded data is shown on the display
  - -- Object with internal structure that arises from multiple marks

System: Baskets
- partition into views side by side
  - various big data
  - object with internal structure that arises from multiple marks

System: Baskets
- partition into views side by side
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System: Baskets
- partition into views side by side
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Partitioning: List alignment
• single bar chart with grouped bars
• split by state into regions
• complete grid vs each region showing all ages
• compare: easy within state, hard across states

Partitioning: Recursive subdivision
• split by neighborhood
• then by type
• then by years as rows—months as columns
• color by price
• neighborhood patterns
–where it’s expansive
–where you pay much more for detached type

System: HIVE

Partitioning: Recursive subdivision
• switch order of splits
–type then neighborhood
• switch color
–by price variation
• type patterns
–within specific type, which neighborhoods inconsistent

System: HIVE

Superimpose layers
• layer: set of objects spread out over region
• extent: whole view
• design choices
–how many layers, how to distinguish?
–encode with different, nonoverlapping channels
–two layers achievable, three with careful design
–small static set, or dynamic from many possible?

Partitioning: Recursive subdivision
• size regions by sale counts
–not uniformly
• result: treemap


System: HIVE

Superimposing limits
• few layers, but many lines
• up to a few dozen
• but not hundreds
• superimpose vs juxtapose: empirical study
–superimposed for local, multiple for global tasks
–local maximum, global slope, discrimination
–same screen space for all multiples vs single superimposed

How to handle complexity: 1 previous strategy + 3 more

Reduce items and attributes
• reduce/increase: inverses
• filter
–pro: straightforward and intuitive
• to reduces and aggregates

System: Crossfilter

Idiom: cross filtering
• item filtering
• coordinated views/controls combined
• all screened histogram builders update when any ranges change

Further reading


http://square.github.io/crossfilter/

Reduce items and attributes
• reduce/increase: inverses
• filter
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System: Crossfilter

Idiom: cross filtering
• item filtering
• coordinated views/controls combined
• all screened histogram builders update when any ranges change

How to handle complexity: 1 previous strategy + 3 more

Reduce items and attributes
• reduce/increase: inverses
• filter
–pro: straightforward and intuitive
–to reduces and aggregates
–out of sight, out of mind
• aggregation
–pro: inform about whole set
–con: difficult to avoid losing signal
–not mutually exclusive
–combine filter, aggregate
–combine reduce, change, facet

Reduce items and attributes
• filter
–pro: straightforward and intuitive
–to reduces and aggregates
–out of sight, out of mind

Static visual layering
• foreground layer: roads
–hue, size distinguishing main from minor
–high luminance contrast from background
• background layer: regions
–desaturated colors for water, parks, land areas
–user can selectively focus attention
–get it right in black and white
–check luminance contrast with grayscale view

Get it right in black and white. Stone. 2010.

http://www.stonesc.com/wordpress/2010/03/get-it-right-in-black-and-white

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Further reading


- Superimpose Layers

System: Crossfilter

Idiom: cross filtering
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• coordinated views/controls combined
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Further reading


Parallel Radial Hierarchical clustering example: cluster-calendar
• derived data:
  - cluster-calendar
• juxtapose multiple views:
  - curves
45

Spatial aggregation
• MAUP: Modifiable Areal Unit Problem
  - gerrymandering (manipulating voting district boundaries) is only one example!
  - zone effects
• scale effects

Task: Correlation
• scatterplot matrix
  - positive correlation
  - diagonal low-to-high
  - negative correlation
  - diagonal high-to-low
  - uncorrelated: spread out
• parallel coordinates
  - positive correlation
  - parallel line segments
  - negative correlation
  - all segments cross a halfway point
  - uncorrelated
  - scattered crossings

Orientation limitations
• rectilinear: scalability wrt #axes
  - 2 axes best
  - 3 problematic
  - 4+ impossible
• parallel: unfamiliarity, training time

Hierarchical clustering example: cluster-calendar
• derived data: cluster hierarchy
• juxtapose multiple views: calendar, superimposed 2D curves

Hierarchical clustering example: scatter plots
• scatterplot with line connection marks
  - popular in journalism
  - horiz + vert axes: value attributes
  - line connection marks: temporal order
  - alternative to dual-axis charts
  - bars vs. time
  - vert. two value attributes
• empirical study
  - engaging line correlation unclear

System: Hierarchical Clustering Explorer
• many linked views
  - cluster heatmap
  - dynamic aggregation: hierarchical clustering
  - explicitly visible
  - fine: 8 clusters

System: Hierarchical Clustering Explorer
• drag line to change level of detail
  - course: 2 clusters
  - fine: 8 clusters

Idiom: histogram
• static item aggregation
• task: find distribution
• data: table
• derived data:
  - new table: keys are bins, values are counts
  - bin size crucial
  - pattern can change dramatically depending on discretization
  - opportunity for interaction: control bin size on the fly

Idiom: boxplot
• static item aggregation
• task: find distribution
• data: table
• derived data:
  - 5 quantiles
  - median, percentiles
  - lower and upper quartile boxes
  - lower-upper fences, whiskers
  - outliers beyond which items are outliers

Idiom: Hierarchical parallel coordinates
• dynamic item aggregation
• derived data: hierarchical clustering
• explicitly visible

Idiom: Continuous scatterplot
• static item aggregation
• data: table
• derived data:
  - key attributes for pixels
  - quantile: overlay plot density
• dense space-filling 2D matrix
• color: sequential
categorical hue • ordered luminance colormap
Finding semantics for synthetic dimensions
• look for meaning in scatterplots
– synthetic dims created by algorithm but named by human analysts
– points represent real-world images (spheres)
– people inspect images corresponding to points to decide if sets could have meaningful names
– cross-check meaning
– arrows show simulated images (teapots) made from model
– check if those match dimension semantics

Understanding synthetic dimensions

[Fig. 14: Matusik et al. A Data-Driven Reflectance Model. SIGGRAPH 2003]

VDA with DR example: nonlinear vs linear
• DR for computer graphics reflectance model
  – goal: simulate how light bounces off materials to make realistic pictures
  – computer graphics BRDF (reflectance)
  – idea: measure what light does with real materials

Capturing & using material reflectance
• reflectance measurement: interaction of light with real materials (spheres)
• result: 104 high-res images of material
  – each image 4M pixels
• goal: image synthesis
  – simulate completely new materials
• need for more concise model
  – 104 materials × 4M pixels ≈ 400M dimensions
  – want concise model with meaningful knobs
  – how shiny/smooth/metallic
  – DR to the rescue!

[Fig. 15: Matusik et al. A Data-Driven Reflectance Model. SIGGRAPH 2003]

Further reading
– Chap 13: Reduce Items and Attributes
  – hierarchy aggregation for information visualization: overview, techniques and design guidelines